Johnson Space Center
USRA Internship Exit Presentation Abstract
Title: HESTIA Commodities Exchange Pallet and Sounding Rocket Test Stand
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Work Number: 281-483-7648
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During my Spring 2016 internship, my two major contributions were the design of the Commodities Exchange Pallet and the design of a test stand for a 100 pounds-thrust sounding rocket. The Commodities Exchange Pallet *(fig. 1)* is a prototype developed for the Human Exploration Spacecraft Testbed for Integration and Advancement (HESTIA) program. Under the HESTIA initiative the Commodities Exchange Pallet was developed as a method for demonstrating multi-system integration thru the transportation of In-Situ Resource Utilization produced oxygen and water to a human habitat. Ultimately, this prototype's performance will allow for future evaluation of integration, which may lead to the development of a flight capable pallet for future deep-space exploration missions.

For HESTIA, my main task was to design the Commodities Exchange Pallet system to be used for completing an integration demonstration. Under the guidance of my mentor, I designed, both, the structural frame and fluid delivery system for the commodities pallet. The fluid delivery system includes a liquid-oxygen to gaseous-oxygen system, a water delivery system, and a carbon-dioxide compressors system (*fig. 2*). The structural frame is designed to meet safety and transportation requirements, as well as the ability to interface with the ER division's Portable Utility Pallet. The commodities pallet structure also includes independent instrumentation oxygen/water panels for operation and system monitoring.

My major accomplishments for the commodities exchange pallet were the completion of the fluid delivery systems and the structural frame designs. In addition, parts selection was completed in order to expedite construction of the prototype, scheduled to begin in May of 2016. Once the commodities pallet is assembled and tested it is expected to complete a fully integrated transfer demonstration with the ISRU unit and the Environmental Control and Life Support System test chamber in September of 2016.

Figure 1. Commodities Exchange Pallet

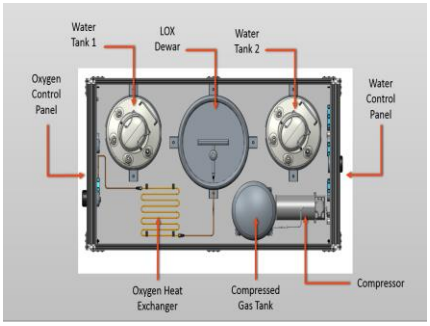

Figure 2: Commodities Pallet Layout (Top View)

In addition to the development of the Commodities Exchange Pallet, I also assisted in preparation for testing the upper stage of a sounding rocket developed as a Center Innovation Fund project. The main objective of this project is to demonstrate the integration between a propulsion system and a solid oxide fuel cell (SOFC). The upper stage and SOFC are scheduled to complete an integrated test in August of 2016. As part of preparation for scheduled testing, I was responsible for designing the upper stage's test stand/support structure and main engine plume deflector to be used during hot-fire testing (*fig. 3*). The structural components of the test stand need to meet safety requirements for operation of the propulsion system, which consist of a 100 pounds-thrust main engine and two 15 pounds-thrust reaction control thrusters. My main accomplishment for this project was the completion of the design and the parts selection for construction of the structure, scheduled to begin late April of 2016.

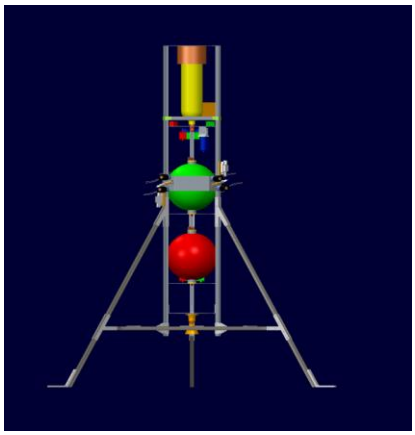

Figure 3. Test Stand and Sounding Rocket Upper Stage Assembly

Through this internship, I have gained valuable design experience. The wide range of disciplines involved in designing these systems allowed me to test my skills and understanding of various engineering principles. I also learned about the complexity of integrating sophisticated sub-systems and the amount of effort and contribution that is required in order to complete such tasks. In all, this experience has been a positive one that has improved both my hands-on and analytical experience; and it is because of this experience that I am motivated to pursue a career in the aerospace industry upon completion of my graduate studies.